# Application of Sleeve Joints between Steel Beams and CFT Columns to Railway Structures

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## Summary

A design equation for estimating the ultimate strength of sleeve joints was presented on the basis of the experimental study. The static loading tests by using the T-shaped sleeve joint specimens were carried out in order to investigate the effects of the diaphragm and the applicability of the sleeve joints to railway structures. The test results indicate that the diaphragm affects the ultimate strength, and that the application of the proposed design method to the T-shaped sleeve joints is promising.

**Keywords**: Concrete-filled steel tube, sleeve joint, ultimate strength, diaphragm.

## 1. Introduction

In recent years, there have been an increasing number of applications of concrete-filled steel tube structures in railway structures. One of the promising applications is to insert the concrete-filled steel tubular column for the required distance into a steel tube of larger diameter, equipped with diaphragms, and fill the annular space between the two with mortar or concrete to form a sleeve joint with external diaphragms [1]. However, there have been few studies on sleeve joints with external diaphragms [2,3], and the failure mechanisms and the ultimate strength of these joints have not been fully clarified.

The authors carried out tests on model specimens of beam-column joints using T-shaped sleeve joints with external diaphragms in order to clarify the transmission mechanisms for bending moments and shear forces, and proposed a design equation for estimating the ultimate strength of the joints [4]. This ultimate strength equation was verified by the monotonic static loading tests on T-shaped sleeve joint specimens. The specimens in the tests had external diaphragms so that the effects of the external diaphragms on the ultimate strength of the joints were examined from the view point of design method.

## 2. Evaluation of ultimate strength for T-shaped sleeve joints

### 2.1 Equilibrium equation of moment

The existing experimental and numerical results for socket joints have suggested that the load bearing mechanism in T-shaped sleeve joints consists of the resistance by a couple of forces caused by the bearing force between the steel tube column and the steel sleeve tube, and by a couple of forces caused by the friction force between the steel tube column and the annular mortar fill [2, 3, 4]. Therefore, we estimated the ultimate strength of the joints from the equilibrium of forces, assuming a load bearing model as shown in Fig.1.

Eq.(1) is an equilibrium equation of moment for the model shown in Fig.1.

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